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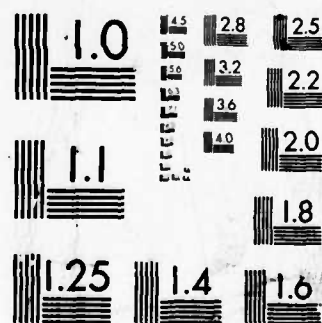
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THESIS

ANALYSIS OF LEASE VERSUS BUY OPTIONS FOR
PROCUREMENT OF RADIO ASSETS FOR THE MARINE
CORPS AIR STATION AT YUMA, ARIZONA

by

Michael Raymond Kanne

September, 1977

Thesis Advisor: LCDR J. C. Robertson, SC, USN

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YUMA, ARIZONA

by

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ABSTRACT

The Marine Corps Air Station at Yuma, Arizona is contemplating whether it is more advantageous to purchase or to lease additional needed radio assets and associated maintenance services.

In order to analyze the situation from an economic standpoint, a cost-benefit study was performed on the alternatives available. Using the Net Present Value concept, the current value of each alternative was determined from the cost data available. In addition, several non-quantitative factors were evaluated in relation to what additional effects they might have on the economic determinations.

Based on the data available, and after considering the potential effects of the non-quantifiable factors, the most favorable alternative was determined to be to purchase the needed radio assets and to perform any necessary maintenance at the government maintenance facilities at the Marine Corps Air Station at Yuma.

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I. INTRODUCTION

The Communications Officer at the Marine Corps Air Station located at Yuma, Arizona (MCAS, Yuma) is solely responsible for the engineering, operation, maintenance and management of all the communications systems used by, and in support of, MCAS, Yuma in the accomplishment of its assigned missions. These varied responsibilities are currently being satisfied through a combination of using: (1) leased assets, such as the commercial telephone equipment; (2) purchased assets, such as the RCA two-way portable radios; and (3) various mixtures of leased and local maintenance programs.

Inherent in the above duties is the requirement not only to design communications systems which satisfy the essential technical requirements of the user, but also to provide the desired services in the most efficient manner available and at the minimum possible cost.

Traditionally, many Marine Corps tactical organizations, bases and stations have attempted to satisfy their requirements for portable radios in short-range (less than three to five miles) communications systems by the use of tactical radios which were a part of the organizations Table of Equipment. (A Table of Equipment is the official list, published by Headquarters, United States Marine Corps, of all major items of combat equipment which a particular organization is authorized.) The most common items of tactical radio equipment used for this purpose were the AN/PRC-25 or the AN/PRC-77 FM radios. Although technically satisfactory for short-range communications, it gradually became apparent that this solution to the communications

requirement had several very significant shortcomings, particularly when employed by garrison organizations (as opposed to Fleet Marine Force combat units.) The major shortcomings were: (1) the radios usually had to be borrowed from tenant Fleet Marine Force (FMP) units, as a base or station does not normally have these types of items in their inventory, unless authorized by some form of special allowance; (2) the expense of operating these radios was prohibitive as they normally employ a non-rechargeable dry cell battery as their power source (\$6.79 each with a useful life of only 30 hours); and (3) the size and weight of the radio (11" x 11" x 4" and 22 pounds with battery) made prohibitive its use by the civilian personnel who, with the passing of time, were becoming the major users of portable, two-way, short-range radios in the course of performing their duties (such as civilian security guards and Public Works employees.)

In view of these obstacles, the use of commercially produced, highly compact and portable two-way radios has become increasingly popular in satisfying the previously mentioned requirements. While seldom found in FMP combat units as they do not possess the degree of ruggedness required of combat equipment, some form of commercial "walkie-talkie" radios will now be found in the inventory of almost all the bases and stations of the Marine Corps, with the most common manufacturers of this type of radio being Motorola, General Electric and RCA.

To date there is considerable controversy as to whether it is more beneficial, in the long run, to lease or to purchase these commercial radios. There currently appears to be no uniform "best solution" that will apply to each and every organization and circumstance. Therefore, each individual situation of lease versus buy has been locally evaluated on the basis of the particular circumstances

existing at a specific installation, with the major criteria frequently appearing to be the ability (not cost) of the installation to effect maintenance on the equipment as opposed to the quality of maintenance available via some type of a leasing arrangement.

This is the current, basic question facing the Marine Corps Air Station at Yuma, Arizona: should they satisfy their need for additional portable radios in support of short-range, reliable, two-way communications by purchasing or by leasing the assets and maintenance services?

It is the intent of this thesis to investigate the particular circumstances surrounding the situation at MCAS, Yuma and to perform an economic evaluation of the alternatives available.

II. NATURE OF THE PROBLEM

A. BACKGROUND

The Marine Corps Air Station at Yuma, Arizona is currently experiencing a significant and sizeable increase in the requirements for portable radios for use in two-way, short-range communications networks. These increased requirements are originating from tenant commands (such as flying squadrons and the HAWK missile battalion), mixed civilian and military Base organizations (such as the Aircraft Intermediate Maintenance Department), and from predominately civilian manned organizations (such as Public Works). All of these requests have either been found to be valid and having merit, or, for the purpose of this study, are presumed to be so. It is envisioned that, at the current rate of growth of requests for portable radios coupled with the possible over-all growth of the Air Station itself, the requirement for this type of communications equipment could increase within two years to as much as 100 percent over FY 1977 levels. (Details of present assets and anticipated future requirements will be discussed in subsequent paragraphs.) Therefore, the most economical means of acquiring and maintaining these assets has become an item of significant concern.

B. PREVIOUS SOLUTIONS

As early as the mid-1960's, MCAS, Yuma recognized the advantages of employing commercially produced radios to satisfy their portable and mobile communications requirements. At that time a family of radios, with attendant accessories and support equipment, was leased from Motorola, Inc. Maintenance services were also leased through a Motorola-approved electronics repair firm located in the city of Yuma, Arizona. Continued problems with the quality and timeliness of the maintenance services provided under the leasing contract ultimately led to the decisions to: (1) terminate the leasing and maintenance contracts with Motorola; (2) purchase the radio equipment from Motorola at a prorated price; and (3) endeavor to perform all necessary maintenance by utilizing a mixture of the civilian and military personnel available at the Station Electronics Maintenance Facility (Appendix A provides a detailed breakdown of the personnel composition of the Electronic Maintenance Facility at MCAS, Yuma.)

The quality of maintenance obtained by following this procedure was felt to be significantly superior to that obtained under the previous leasing arrangement. (Although records are no longer available to support this contention, extensive interviews with maintenance supervisory personnel at MCAS, Yuma unanimously support this claim.) Therefore, when the decision was made to replace the Motorola radios in 1974 by what was felt to be a technically superior family of radios produced by RCA, it was also decided that the new radios would be purchased instead of leased, and that the maintenance services would continue to be performed by the Station Electronics Maintenance Facility. Here it appears

that the ready availability of a technically satisfactory maintenance facility was the major factor in the decision to purchase RCA radios; it is not known if, and to what extent, the relative cost factors of lease versus buy were considered.

C. CURRENT PROCEDURES

The Marine Corps Air Station at Yuma, Arizona currently continues to purchase all of the RCA radio equipment that it uses. Several supplementary purchases of the RCA radios, accessories and support equipment have occurred between 1974 and present. As a consequence, MCAS, Yuma currently has the following major items of RCA radios and associated equipment in its inventory:

- 72 RCA "TACTEC" model portable radios
- 28 RCA "700" model vehicular mounted radios
- 28 RCA "1000" model vehicular mounted radios
- 8 RCA 12-position multiple battery chargers
- 17 RCA 1-position battery charger
- 20 RCA "PERSONALERT" pagers
- 1 RCA "SUPERCONTROLPHONE 500" master unit
- 20 RCA battery chargers for pagers

The current anticipated increased requirements are primarily in the area of the RCA "TACTEC" model radios and associated accessories.

Maintenance of the RCA radio equipment continues to be

accomplished by the Mobile Section of the Station Electronics Maintenance Facility. The actual maintenance services are performed primarily by military personnel, with the average rank of Corporal, and by civilian technicians of pay level WG-11 (who are assigned, as needed, from other Sections of the Electronic Maintenance Facility.) Both military and civilian technicians who perform maintenance on the RCA equipment are under the Staff Sergeant supervisor of the Mobile Section. Newly arrived military personnel assigned to the Mobile Section are familiarized with the proper maintenance and repair procedures for the RCA family of radios primarily by on-the-job training, again under the over-all supervision of the Mobile Section supervisor. On the average it is estimated that approximately two man-hours of labor per day are devoted to the maintenance and repair of these radios by the personnel assigned to the Station Electronics Maintenance Facility. Currently the major portion of the labor time is being done primarily by military personnel. However, this situation changes with the availability and level of expertise of the Marines assigned.

Each individual organization which uses the RCA "TACTEC" portable radios, and the companion "700" or "1000" series of mobile-mounted radios, has its own particular set of frequencies to use for its own communications networks. For major users of the equipment, or for those organizations for whom continuous, reliable communications is a virtual necessity, the Electronic Maintenance Facility retains one or more extra RCA "TACTEC" radio sets which have frequency crystals pre-set to the frequencies allocated to that particular using unit. Thus, these units are capable of effecting a direct exchange with the Electronic Maintenance Facility for any RCA "TACTEC" radio which is malfunctioning. Thus down-time is minimized, and upon repair of the malfunctioning radio, it is then retained by the Electronic

Maintenance Facility as part of the using units reserve.

All of the RCA "TACTEC" radios have an initial one-year warranty on parts. Thus, any repair parts required during the initial year of operation are provided, as needed, by the RCA Corporation free of charge, provided the Electronic Maintenance Facility informs RCA of the situation.

D. EFFECTIVENESS OF PRESENT MAINTENANCE SYSTEM

The current practice of the Electronic Maintenance Facility performing the required maintenance and repair on the family of RCA radios and associated equipment appears to be quite satisfactory from the aspect of satisfying the requirements for rapid and technically sound repair of those assets.

Presently within the Marine Corps there is neither a formal uniform system of procedures nor a required record of maintenance as pertains to the maintenance of commercial equipment. As a matter of standard practice, most of the maintenance facilities in the Marine Corps will attempt to effect the same, or very similar, basic maintenance procedures and record keeping systems with their commercial equipment as is required for their military items of equipment.

While the basic procedures and records systems employed by the Electronic Maintenance Facility at MCAS, Yuma are quite similar to those used by FMF units in the maintenance of their military equipment, the absence of any consistent means of accounting for the number of man-hours of labor dedicated to the maintaining and repairing of the RCA equipment makes it necessary to estimate this cost factor.

The lack of a truly sound and reliable overall documentation system of the cost of repair parts (particularly prior to June 1976), and the inability to identify easily and readily the costs of repair parts with a particular item of equipment makes the costing of maintenance parts during a particular timeframe exceedingly difficult. In addition, there is evidence of a fair number of incidents where repair parts were ordered, and paid for, while the item of equipment being repaired was still under warranty. All of these factors will tend to frustrate any attempts by management to effect any detailed control of maintenance costs.

To summarize the above, the maintenance system employed by the Electronic Maintenance Facility is effective from the aspect of getting the commercial radio equipment repaired. However, the documentation and record keeping systems are not providing management with the timely and accurate information required in order to manage maintenance costs.

E. ANTICIPATED FUTURE REQUIREMENTS THRU FY 79

During FY78 MCAS, Yuma is anticipating an increased requirement of up to 40 of the RCA "TACTEC" radios, with the possibility of an increased requirement equally as large during FY 79. Also, 29 of the RCA "TACTEC" radios currently on hand will be five years old during FY79 and as a result, replacement with newer equipment may be desired. In addition, appropriate accessories and support equipment will be required for the new radios.

In view of the above anticipated requirements, MCAS, Yuma wishes to investigate what is the most economical way in which to satisfy these requirements.

III. PROPOSED SOLUTIONS

A. MILITARY EQUIPMENT

In addition to the previously mentioned drawbacks inherent to the use of military radios (size, weight, cost) frequency incompatibility (32 to 75 Mhz range for the military family of VHF radios as opposed to a 132 to 174 Mhz range for the RCA family of VHF radios currently being used at MCAS, Yuma) precludes any mixture of the two families of equipment. Therefore, the use of any of the standard military portable VHF radio equipment is not viewed as a satisfactory solution to the problem.

B. PURCHASE ADDITIONAL RADIOS FROM RCA

This approach would be a continuation of the current procurement policies and would satisfy the requirements for additional equipment. Maintenance and repairs, although increased in quantity by the addition of the new equipment, would continue to be performed by the Electronic Maintenance Facility at MCAS, Yuma.

**C. PURCHASE ADDITIONAL RADIOS FROM RCA AND LEASE THE
MAINTENANCE SUPPORT**

As in the proposed solution (B) above, this would also satisfy the needed equipment requirements. In addition, it would also prevent any possible over-commitment of the maintenance assets at the Electronic Maintenance Facility at MCAS, Yuma.

D. LEASE ADDITIONAL RADIOS FROM RCA

Inherent in any agreement to lease the radio equipment is also leased maintenance for the same equipment. As in proposed solutions (B) and (C) above, this approach would also be a suitable solution to the radio equipment requirement.

IV. LEASE VERSUS BUY

A. GENERAL

Of the four possible solutions offered in the previous chapter, only the last three are viewed as being feasible. In determining which of these alternatives is the most desirable, a cost-benefit analysis shall be conducted which will consider both economic and system performance factors.

The question of whether or not to lease or buy an asset has been the subject of extensive debate and controversy in the recent past, particularly in the private industry sector. Here, leasing is a frequent and widely used method of securing the use of needed or desired assets. However, in the private industry sector both leasing and purchasing may have certain tax advantages, depending on the particular circumstances, which are not available to those in the governmental sector of the economy. The absence of this tax advantage feature could significantly effect the economic desirability of one or the other alternative in a particular set of circumstances.

Many current periodicals which address the question of whether to lease or buy will frequently leave the impression that the ultimate solution should usually favor leasing. The current advantages of leasing, however, must be fairly well balanced by the advantages of ownership as there appears to be no dramatic changes in the favoring of either choice. The major argument favoring ownership has traditionally been

that of lower total costs. Leasing firms have attempted to counter this argument by stating that one of the major keys to success for leasing has been the comparative ease in computing, and predicting, total costs to the lessee. This feature, it is claimed, significantly facilitates the forecasting, and managing, of a budget. Lessors continue to promote the idea that the typical organization should be primarily an equipment user, and not a buyer, seller or maintainer. Leasing advertisements typically cite the factors of release of capital for other investments, tax advantages, and assured quality of maintenance as prime reasons for opting for a leased equipment operation.

B. ADVANTAGES

The following is a partial listing, derived from several sources, of the benefits of both leasing and buying of assets as they apply to the governmental sector of the economy.

First, the basic advantages of leasing:

1. There is no requirement for any initial investment of capital in equipment.
2. The equipment costs are a virtually predetermined amount for budgeting purposes.
3. There is no requirement for the using organization to maintain extensive maintenance and operating records, and many tedious reports are eliminated.
4. When maintenance services are part of the leasing package the user eliminates the need for maintenance facilities and maintenance personnel.
5. Flexibility of operation is enhanced by the ability of the user to easily lease additional equipment for a short or long period of time to meet peak or changing

requirements.

6. The equipment is automatically replaced, at stated intervals, with new equipment.

As opposed to the factors cited above, the following are the commonly recognized advantages of ownership:

1. Mission requirements are considered to be satisfied if the allowance is adequate and filled.

2. The pride of ownership often results in better and more conscientious care of the equipment.

3. The military maintenance and service personnel, and maintenance facilities, are available 24 hours per day, seven days a week.

4. Local Marine Corps management policy tends to be based on service to the customer as opposed to purely the lowest quoted rates.

5. Generally, lower total costs.

C. BUDGET CONSIDERATIONS

The lease versus buy question has an important additional implication when applied to the government sector. With any Marine Corps owned equipment, part of the expense associated with it is the initial purchase price. At the time of purchase, the funding comes directly from the procurement appropriation, while the cost of operating and maintaining the item of equipment is borne by the operations and maintenance (O & M) appropriation.

In contrast to this procedure, the entire cost associated with the leasing of any equipment is charged to the O & M appropriation. Therefore, under certain circumstances of budgetary restraints, this factor alone may force a decision to lease an item of equipment instead of

purchasing it.

D. TIME VALUE OF MONEY

The primary economic evaluation technique which will be used in the course of this analysis is that of equating all future expenditures and costs to their present monetary value. A detailed explanation of the Time Value of Money concept is included in Appendix B.

V. ANALYSIS OF ALTERNATIVES

A. OBJECTIVE

The primary purpose of this economic analysis is to determine the least expensive means of acquiring the use of an additional 40 RCA "TACTEC", 6 channel, 4 frequency, 6 watt FM radios in order to satisfy the anticipated FY78 requirements for additional assets in this area.

B. ALTERNATIVES

The alternatives to be analyzed are as presented in Chapter III. Again, these alternatives are:

1. Purchase the desired 40 radios, and accessories, from the RCA Corporation and perform the required maintenance and repair (other than that covered by warranty) with personnel assigned to or employed by the Marine Corps Air Station at Yuma.

2. Purchase the desired 40 radios, and accessories, from the RCA Corporation and have the maintenance and repair performed, via a leased agreement, by RCA.

3. Lease the desired 40 radios, and accessories, from the RCA Corporation. In this event the maintenance would also be performed by RCA as part of the basic lease agreement.

C. ASSUMPTIONS

In the course of this evaluation, certain assumptions have been made. These assumptions are as follows:

1. The RCA radios, accessories, and support equipment currently owned by MCAS, Yuma will continue to be retained and maintained as per current arrangements, at least until the termination of the useful life of the item of equipment. Thus the analysis will be done only on the FY78 incremental procurement of the 40 RCA "TACTEC" radios.

2. Other than the indicated accessories, no additional support or ancillary equipment will be required as a result of the acquiring the use of the 40 additional radios.

3. Both procurement and O & M funds are available either for the purchase or the lease of these radios, as appropriate.

4. The current level and quality of maintenance expertise will remain available to the Electronics Maintenance Facility at MCAS, Yuma for the foreseeable future.

5. The economic life of the radios, and accessories, is five years.

6. The appropriate discount rate to be used is ten percent (DoD Instruction 7041.3.)

7. The effects of inflation tend to effect all alternatives equally and thus they are disregarded.

8. The salvage value of a purchased radio is approximately equivalent to the "turn-in" value of a leased radio. Therefore, these values are not relevant to this analysis and thus will be disregarded.

9. Both possible sources of maintenance (government performed or leased from RCA) will provide the required level of equipment availability.

10. The net present value (NPV) of the cash flows will be calculated for each alternative and will be the basis for financial comparison. Present value is given by the formula:

$$NPV = PMT \frac{1}{(1 + i)^n}$$

where "i" is the discount rate and "n" is the number of years in the future.

D. NET PRESENT VALUE COMPARISON OF ALTERNATIVES

1. First Alternative

The costs relative to alternative number one (purchase the radios and perform maintenance) are the initial capital expenditure required to procure the needed radios and the annual costs associated with the procurement of parts required for the maintenance and repair of the equipment.

The initial purchase price of the RCA "TACTEC" radios is based on the pricing procedures stipulated in the General Services Administration (GSA) Contract number GS-00S-44630 and the prices quoted in the most current RCA price lists. The detailed list of the anticipated equipment needs, and associated costs to the Marine Corps, based upon the GSA contract prices, are presented in Figure 1 below.

RADIO REQUIREMENTS

Figure 1 - ANTICIPATED FY78 PORTABLE RADIO REQUIREMENTS

In computing maintenance costs, the cost of direct labor was not included. Upon extensive interviews with key maintenance and supervisory personnel associated with the MCAS, Yuma Electronics Maintenance Facility, it was concluded that the additional maintenance effort associated with the acquisition of the items listed in Figure 1 was well within the capability of the present workforce to absorb. Therefore, there is no requirement to obtain additional maintenance personnel (either civilian or military) as a consequence of purchasing the radio assets.

The anticipated cost of repair parts is based upon the records currently available at the Electronic Maintenance Facility. Consideration was given to the factors presented in Chapter II (D), and as a consequence, known costs were increased by ten percent in an attempt to be prudently conservative in the estimates of future costs. Note that during year number one the cost of repair parts will be zero as the requirement will be covered by warranty, and mailing costs are viewed as nominal.

Based on the past records, the cost of future repair parts will be as listed below:

YEAR	COST (\$)
1	0
2	1205
3	1365
4	1525
5	1685

The net present value of the costs associated with alternative number one are as presented in Figure 2 below.

NET PRESENT VALUE
PURCHASE WITH GOVERNMENT MAINTENANCE

YEAR	0	1	2	3	4	5
CASH OUTFLOW (\$)						
PURCHASE PRICE	46002	0	0	0	0	0
MAINTENANCE	0	0	1205	1365	1525	1685
NET CASH OUTFLOW	46002	0	1205	1365	1525	1685
PV FACTOR	1	.909	.826	.751	.683	.621
PV OF CASH OUTFLOW	46002	0	996	1025	1042	1046
NET PRESENT VALUE OF NET CASH OUTFLOW						\$50,111

Figure 2 - NET PRESENT VALUE
PURCHASE WITH GOVERNMENT MAINTENANCE

2. Second Alternative

The costs relative to alternative number two (purchase the radios and lease the maintenance) are the initial capital expenditure required to procure the needed radios, and the annual costs of leasing the maintenance services from RCA.

The cost of the leased maintenance services are also based on the pricing procedures stipulated the GSA Contract number GS-00S-44630 and on the prices quoted in the most current RCA price lists. The leasing costs for maintenance of the items listed in Figure 1 are as follows:

ITEM	COST PER MONTH PER ITEM	
	FIRST YEAR	YEAR 2 TO 5
RCA "TACTEC" RADIO HCB36-DA63	6.00	8.00
BATTERY CHARGERS MI-559719-GI	.60	.60
SPARE BATTERY MI-559747C	1.70	1.70

Therefore, the total annual cost of leased maintenance is as follows:

40 RCA "TACTEC" RADIO	\$ 2880	\$ 3840
20 BATTERY CHARGERS	144	144
20 SPARE BATTERIES	408	408
TOTAL	\$ 3432	\$ 4392

The net present value of the relative costs associated with alternative number two are as presented in figure 3 below.

NET PRESENT VALUE						
PURCHASE WITH LEASED MAINTENANCE						
YEAR	0	1	2	3	4	5
CASH OUTFLOW (\$)						
PURCHASE PRICE	46002	0	0	0	0	0
MAINTENANCE	0	3432	4392	4392	4392	4392
NET CASH OUTFLOW	46002	3432	4392	4392	4392	4392
PV FACTOR	1	.909	.826	.751	.683	.621
PV OF CASH OUTFLOW	46002	3120	3629	3300	3000	2727
NET PRESENT VALUE OF NET CASH OUTFLOW	\$61,778					

Figure 3 - NET PRESENT VALUE
PURCHASE WITH LEASED MAINTENANCE

3. Third Alternative

The costs relative to alternative number three (lease the radios from RCA) are the annual leasing costs associated with the use of the equipment and the annual leasing costs associated with the maintenance services provided by RCA.

The costs of leased maintenance were presented in the discussion of the second alternative. In accordance with the GSA Contract and the current RCA price catalog, the leasing costs associated with the equipment usage over a five year period are as follows:

ITEM	NUMBER	MONTHLY COST	TOTAL CCST
		PER ITEM	PER YEAR
RCA "TACTEC" RADIO	40	\$26.12	\$12,537.60
CARRYING CASE	40	.39	187.20
BATTERY CHARGER	20	1.23	295.20
SPARE BATTERY	20	1.40	336.00
		TOTAL	\$13,356.00

The net present value of the relative costs associated with alternative number three are as presented in Figure 4 below.

**NET PRESENT VALUE
LEASE WITH LEASED MAINTENANCE**

YEAR	0	1	2	3	4	5
CASH OUTFLOW (\$)						
EQUIPMENT LEASE	0	13356	13356	13356	13356	13356
MAINTENANCE LEASE	0	3432	4392	4392	4392	4392
NET CASH OUTFLOW	0	16788	17748	17748	17748	17748
PV FACTOR	1	.909	.826	.751	.683	.621
PV OF CASH OUTFLOW	0	15260	14667	13334	12122	11020
NET PRESENT VALUE OF NET CASH OUTFLOW						\$66,403

**Figure 4 - NET PRESENT VALUE
LEASE WITH LEASED MAINTENANCE**

E. AN ALTERNATE APPROACH

It was previously stated in evaluating alternative number one that the cost of direct labor was not applicable as there would be no increase in the labor force as a consequence of following this course of action.

Another way of approaching this situation is to view whatever labor is required to maintain the additional equipment as labor removed from some other effort, or as causing additional delays in the timeliness of maintenance. Therefore, this labor does have a value equal to the hourly wage of the technicians involved in the maintenance multiplied by the number of hours required to effect the maintenance.

It is estimated that the additional equipment to be procured will require, on the average, one man-hour per day to maintain, or 250 man-hours per year.

Based on the supposition that 75 % of the labor effort is performed by military personnel of the rank of corporal (E-4) and 25 % is performed by civilians in the paygrade WG-11, then the projected yearly labor cost (basic wage plus fringe benefits) associated with the additional equipment is approximately \$1200. (Wage rates are based on information cited in the current Naval Postgraduate School publication "Practical Comptrollership".)

Inserting this figure into the net present value calculations presented in Figure 2 above, we get the following results:

NET PRESENT VALUE
PURCHASE WITH GOVERNMENT MAINTENANCE
(LABOR COSTS CONSIDERED)

YEAR	0	1	2	3	4	5
CASH OUTFLOW (\$)						
PURCHASE PRICE	46002	0	0	0	0	0
MAINTENANCE						
LABOR	0	1200	1200	1200	1200	1200
PARTS	0	0	1205	1365	1525	1685
NET CASH OUTFLOW	46002	1200	2405	2565	2725	2885
PV FACTOR	1	.909	.826	.751	.683	.621
PV OF CASH OUTFLOW	46002	1091	1987	1926	1861	1792
NET PRESENT VALUE OF NET CASH OUTFLOW						\$54,659

Figure 5 - NET PRESENT VALUE
PURCHASE WITH GOVERNMENT MAINTENANCE
(LABOR COSTS CONSIDERED)

F. NON-QUANTIFIABLE FACTORS

In addition to the economically measurable factors explored in the previous paragraph, there are several other items which, although not easily equated to a cost figure, may have a bearing on which is the best course of action to pursue. The most significant of these are:

1. The current system of maintaining and repairing the equipment has proven to produce satisfactory results in a reasonably timely manner (the average time of repair is currently approximately 28 days, and the major portion of this time is attributed to awaiting the arrival of repair parts from RCA.) The results under a leasing arrangement are an unknown.

2. Currently, minor repairs not requiring repair parts (such as soldering a loose connection or performing a minor adjustment) are often performed at the very time that the item is brought in for repair. Under a leasing arrangement this type of efficient "quick fix" would no longer be performed.

3. As more and more items are added to the inventory with the passage of time, eventually it will be necessary to increase the number of technicians employed under the local government maintenance concept.

4. The non-availability of either procurement or O & M funds at the time of needed procurement could virtually dictate the course of action, regardless of the outcome of any NPV analysis.

G. SUMMARY OF THE RESULTS OF THE NET PRESENT VALUE ANALYSIS

A recapitulation of the present value of all acceptable alternatives is shown in Figure 6.

SUMMARY
NET PRESENT VALUES OF ALTERNATIVES

ALTERNATIVES	NET PRESENT VALUE
1. Purchase the equipment from RCA and perform maintenance with government personnel (labor costs ignored)	\$50,111
2. Purchase the equipment from RCA and perform maintenance with government personnel (labor costs included)	\$54,659
3. Purchase the equipment from RCA and lease the maintenance services from RCA	\$61,778
4. Lease the equipment from RCA	\$66,403

Figure 6 - SUMMARY
NET PRESENT VALUES OF ALTERNATIVES

VI. SUMMARY AND CONCLUSIONS

The Marine Corps Air Station at Yuma, Arizona is faced with the need to acquire additional portable radios in order to satisfy a growing communications requirement. Although their pattern in recent years has been to purchase assets of this nature, there is now a desire to explore the possibility of leasing instead of buying. Therefore, the economic analysis of the lease versus buy options available to MCAS, Yuma was performed and constitutes the core of this thesis. In addition, several non-quantifiable factors were presented which, under the proper set of circumstances, could override purely economic considerations.

The results of the economic analysis of the various options being considered are presented in Figure 6. Based on the data available, the option of purchasing the needed radios and accessories combined with government performed maintenance has a considerable economic advantage over the other alternatives considered.

However, it should be kept in mind that the cost figures used in connection with estimating expenses associated with future government performed maintenance (parts and labor) are based on a limited amount of data and as such are subject to the possibility of some degree of inaccuracy. Should these costs be significantly understated it could alter any apparent economic advantage of purchasing and using government maintenance assets.

With the exception of possible non-availability of procurement funds, there is no other non-quantifiable

consideration presented in chapter V(F) which appears to have the potential of altering the economic desirability of the purchase option. Obviously, if procurement funds should not be available then either the radios will have to be obtained via a leasing arrangement, or procurement will have to be delayed until the needed funding is programmed.

In conclusion, to purchase the equipment and to maintain it by the employment of government facilities appears to have a considerable economic advantage, and if funding is available, this course of action should be considered as the best approach to pursue in view of the particular circumstances now present at MCAS, Yuma.

APPENDIX A

PERSONNEL STRUCTURE OF THE ELECTRONIC MAINTENANCE FACILITY AT MCAS, YUMA

NR	RANK	SPECIALITY DESIGNATOR	BILLET
1	CAPT	5950	Electronic Maintenance Officer
1	MSGT	5959	Electronic Maintenance Chief
1	GYSGT	5954	Electronics Shop Chief
1	SSGT	5954	Quality Control Coordinator
1	GS-11	0850	Electronics Technician

FM MOBILE SECTION

1	SSGT	5954	ATC Communications Technician
1	SGT	5958	ATC Communications Repairman
1	SGT	2861	Radio Technician
3	CPL	2841	Radio Repairman
1	SSGT	2853	AVN Metro Equipment Technician
2	SGT	5952	ATC NavAids Technician
2	WG-11	2614	Electronics Mechanics
2	CPL	2853	AVN Metro Equipment Technician

TRANSCEIVER SITE SECTION

1	SSGT	5954	ATC Communications Technician
3	SGT	5958	ATC Communications Repairman

2	WG-11	2614	Electronics Mechanic
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INSTRUMENT RANGE SECTION

2	SGT	5953	ATC Radar Technician
1	SGT	5954	ATC Communications Technician
4	WG-11	2614	Electronics Mechanic
1	CPL	5958	Communications Repairman

DSTE SECTION

1	SSGT	2826	DSTE Chief
1	SGT	2826	DSTE Technician
1	CPL	2819	Repairman

APPENDIX B

PRESENT VALUE CONCEPT

The major aspect that complicates the comparison of the two ways of acquiring (lease or buy) is that the timing of the costs to be incurred under the two acquisition methods differs significantly. In a typical case, purchasing requires the immediate incurrence of a large one-time cost, while leasing involves a series of smaller annual costs that are greater than the one-time purchase cost. The implication of this time difference, for the purpose of comparing costs, is that the costs associated with each system cannot be merely summed and compared. To do so would imply that a unit of money has equal value regardless of when it is received or spent.

The fact that money, if invested, has earning power results in a dollar received now being of greater value than a dollar to be received at some time in the future. The reason for this is that the dollar received now can earn interest, with the result that by the time the "future" dollar is received, the first dollar will have grown in worth to more than \$1.

If it were appropriate to sum merely the costs of leasing and compare them with those of purchasing, the choice invariably would be to purchase since, in terms of total dollars, leasing requires a larger expenditure. However, when the time value of money is considered, the analysis may show leasing to be the less costly method.

To arrive at a decision as to the comparative economic desirability of leasing or buying, it is necessary to determine the opportunity costs associated with the alternative means of acquisition. Thus the including in the analysis of the economic implications of the time value of money is one of the major aspects of any lease versus buy comparison.

There are several ways in which the time value of money can be included in a comparative analysis of a lease versus buy situation. In each instance it is necessary first, to identify the categories of costs to be incurred under each method and second, to determine the magnitude of each cost element and the period during which it will be incurred.

These steps result in the development of two cost streams; the first would be incurred if the decision were to purchase and the second would be incurred if the decision were to lease. To compare the two cost streams, it is necessary to convert each cost stream into a single value that represents the total value of that cost stream at a single point in time (the point being the same for both cost streams.) The point in time chosen for the comparison could be any time. By convention, the time chosen is usually the present time, when "present" may be defined as the beginning of the period during which the costs would be incurred or the time when the decision to lease or purchase is to be made. Converting the cost streams in this manner is referred to as calculating the present value of the costs, or discounting the costs.

To calculate the present value of a cost stream requires, first, converting each estimate of costs to be incurred into its present value, and second, summing all the individual present values to arrive at the total present value costs.

The conversion of an individual cost estimate into its present value consists of calculating the amount that would be required to be invested at the present time in order to provide enough funds to pay for that cost. For example, if the cost in the third year of a lease period was to be \$10,000, the present value cost associated with that third year would be an amount that, if invested at the present time, would total (in principal and interest) \$10,000 by the third year. Thus, we can see that the present value of a future cost is always an amount smaller than the estimated future cost. The further into the future the time period, the smaller the present value of any cost to be incurred in that period.

The relationship between length of time in the future at which a cost is to be incurred and its present value can be seen in the below example which shows the present value at an interest (discount) rate of ten percent for \$1000 of cost to be incurred at the end of each of the next five years.

END OF YEAR	PRESENT VALUE
1	\$ 909
2	826
3	751
4	683
5	621

TOTAL \$ 3790

The total present value of \$3790 shown above is the amount of money that, if invested at the present time at an interest rate of ten percent, would generate a series of

repayments of \$1000 a year for a five year period. Clearly, to convert any cost estimate into its present value it is necessary to use an interest rate to determine what amount would be required to be invested to meet that future cost. In such calculations, the rate used should be that rate that best reflects the time value of money to the party in whose interest the comparative analysis is being made.

As was the case of the present value of a future cost being smaller the further into the future the time period involved, so is it the case of a future cost being smaller the higher the discount rate used. The below illustration demonstrates this by showing the present value of a cost of \$1000 to be incurred ten years from now under each of a variety of discount rates.

DISCOUNT RATE	PRESENT VALUE
5 %	\$ 614
7 %	508
10 %	385
12 %	322
15 %	247
20 %	162

The present value is lower in calculations using higher discount rates since, at higher interest rates, the principal amount required to be investigated to meet the future cost obviously would not be as great as would be required if a lower interest rate were in effect.

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